CIVIL AND ARCHITECTURAL ENGR (CAE)

CAE 100
Introduction to Engineering Drawing and Design
Introduction to engineering graphics as a problem-solving tool. Basic traditional techniques of orthographic projection, multi-view, pictorial, auxiliary views, dimensioning and tolerance, sectioning, detail drawing. Use of ANSI standards; applications in civil, architectural, and engineering design.
Lecture: 1 Lab: 2 Credits: 2
Satisfies: Communications (C)

CAE 101
Introduction to AutoCAD Drawing and Design
A continuation of CAE 100. Use of PC-based CAD (Computer-Aided Drawing and Design) software for presentation and problem solving in civil and architectural engineering applications. Introduction to basic principles of design.
Prerequisite(s): CAE 100
Lecture: 1 Lab: 2 Credits: 2
Satisfies: Communications (C)

CAE 105
Surveying
Surveying and related tools and skills needed to design, build, and maintain infrastructure. Study of leveling, traversing, topographic mapping, route surveying, earthwork computation, photogrammetry, and 3D lidar. Practice in the use of auto levels, tapes, total stations, global position systems (GPS), geographic information systems (GIS), and computer-based methods in surveying.
Prerequisite(s): CAE 100*, An asterisk (*) designates a course which may be taken concurrently.
Lecture: 2 Lab: 0 Credits: 2

CAE 110
Professional Practice I
This course is an introduction to the engineering profession. The content and delivery have been designed to challenge the student’s perspective of oneself and thus make the student a better engineer. The class focus is on developing the skills to become a professional learner and a successful student, increasing team learning skills, self-reflection, enhancing ethical perception and decision making abilities, and understanding the responsibilities as an engineer. In simple terms, the student will begin to "act as an engineer acts."* Lecture: 1 Lab: 0 Credits: 1

CAE 111
Professional Practice II
This course continues the introduction to the engineering profession with further studies of team learning, specializations in engineering, enhancing ethical perception and decision making abilities, and understanding the responsibilities as an engineer. The course also looks deeply at the need for continuous innovation by studying and practicing the entrepreneurial mindset needed to create value for oneself as the student, for one's company, and for society. In simple terms, the student will begin to "act as an engineer acts" and "think like an entrepreneur thinks."
Lecture: 1 Lab: 0 Credits: 1

CAE 208
Thermodynamics
Basic principles of thermodynamics applied to engineering systems using pure substances and mixtures as working fluids. Direct application of the laws of thermodynamics to analysis of closed and open systems, mass and energy flow. Extensive analysis of isentropic processes in cycles and analysis of gas mixtures.
Prerequisite(s): ((CHEM 122 and CHEM 123) or CHEM 124) and (MATH 152 and PHYS 123)
Lecture: 3 Lab: 0 Credits: 3

CAE 209
Fluid Mechanics and Heat Transfer
Introduction to fluid mechanics and analysis of fluid statics problems. Introduce and develop heat and mass transfer analysis techniques. Description and analysis of fluid kinematics, energy and momentum equations applied to internal/external flow in building engineering systems. Development and application of convection, conduction and radiation to one-, two- and three-dimensional systems in steady state and transient regimes of operation as applied to building materials and geometries.
Prerequisite(s): CAE 208 and (MATH 252* or CAE 320), An asterisk (*) designates a course which may be taken concurrently.
Lecture: 3 Lab: 0 Credits: 3

CAE 221
Engineering Geology
Geology and its relationship to civil engineering; minerals; rocks; soil formation; geologic structure; groundwater hydraulics; frost action in soils, landslides, shoreline erosion, bluff instability; earthquakes; air photo interpretation, soil and rock mechanics in relation to engineering geology; subsurface exploration; dams, reservoirs, tunnels; case-history illustrations.
Lecture: 2 Lab: 2 Credits: 3

CAE 286
Theory and Concept of Structural Mechanics
Prerequisite(s): PHYS 123 and MATH 152
Lecture: 3 Lab: 0 Credits: 3

CAE 287
Mechanics of Structural Materials
The concepts of deformation, strain, and stress. Application of free body diagram in shear force and bending moment diagram. Elementary bending theory, normal and shear stresses in beams, and beam deflection. Axially loaded members and Euler buckling theory. Plane stress and strain, Mohr’s circle, and torsion of circular sections. Combined loading.
Prerequisite(s): CAE 286
Lecture: 3 Lab: 0 Credits: 3
CAE 302
Fluid Mechanics
Fundamental concepts; fluid properties; fluid statics; fluid kinematics; mass, energy, and momentum concepts; dimensional analysis; laminar and turbulent flow in closed conduits; flow in open channels; turbo machinery; drag forces; fluid measurement.
Prerequisite(s): MATH 252* and (CAE 286 or MMAE 200), An asterisk (*) designates a course which may be taken concurrently.
Lecture: 3 Lab: 0 Credits: 3

CAE 303
Steel Structures I
Introduction to and discussion of Load and Resistance Factor Design and Allowable Stress Design, as well as their applicable load combinations, resistance factors and factors of safety as applied to steel structures – and their relationships with underlying concepts of structural behavior. Analytical study of steel materials subjected to various states of stress. Failure theories, yield and post-yield criteria. Design of tension members, columns, and beams, and simple connections for steel structures.
Prerequisite(s): CAE 287 and CAE 304 and CAE 315*, An asterisk (*) designates a course which may be taken concurrently.
Lecture: 3 Lab: 0 Credits: 3
Satisfies: CAE Design Course (D)

CAE 304
Structural Analysis I
Prerequisite(s): MATH 252 and CAE 287
Lecture: 3 Lab: 0 Credits: 3

CAE 307
Concrete Structures I
Prerequisite(s): CAE 287 and CAE 304 and CAE 315
Lecture: 3 Lab: 0 Credits: 3
Satisfies: Communications (C), CAE Design Course (D)

CAE 312
Engineering Systems Analysis
Systems concept process, interest rate, present and future worth values, evaluation of alternatives, and elements of microeconomics. Theory of probability, laws of probabilities, random variables and distribution functions, functions of random variables, statistical estimations of data, mean and standard deviation, correlation, and regression analysis.
Prerequisite(s): MATH 251
Lecture: 3 Lab: 0 Credits: 3

CAE 315
Materials of Construction
Physical principles of elastic and plastic deformation of construction. Mechanical testing methods including tensile, compressive, toughness, creep and fatigue. Properties of concrete, wood, iron and steel and other construction materials. The emphasis is on concepts from solid mechanics which explain the behavior of materials to the extent needed in the design of load-bearing constructs.
Prerequisite(s): CAE 287
Lecture: 3 Lab: 0 Credits: 3
Satisfies: Communications (C)

CAE 331
Building Science
Study of the physical interactions between buildings, people, and climate (i.e., temperature, humidity, wind, sun, rain, snow, etc.). Topics include: heat transfer, psychrometrics, thermal comfort, indoor air quality, ventilation, infiltration, solar insolation, heating and cooling load calculations, building energy efficiency, and building codes.
Prerequisite(s): (CAE 208 or (MMAE 320 and CAE 209)) and (CAE 302 or MMAE 313)
Lecture: 3 Lab: 0 Credits: 3

CAE 383
Electrical and Electronic Circuits
Prerequisite(s): MATH 252 and PHYS 221
Lecture: 2 Lab: 2 Credits: 3

CAE 401
Hydraulics, Hydrology, and Their Applications
Prerequisite(s): MATH 252*, An asterisk (*) designates a course which may be taken concurrently.
Lecture: 2 Lab: 3 Credits: 3
CAE 402
Introduction to Environmental Engineering and Sustainable Design
This course provides an overview of how environmental engineers integrate biological, chemical, and physical sciences with engineering design methods to develop solutions to environmental problems. Topics include air pollution, water pollution, solid waste management, fate and transport of contaminants, pollution prevention, environmental regulation, risk assessment, climate science, and sustainability assessment. Focuses on applications and actual design practice.
Prerequisite(s): MATH 152 and CHEM 124
Lecture: 3 Lab: 0 Credits: 3
Satisfies: CAE Design Course (D)

CAE 405
Applications of Computational Fluid Dynamics in Engineering
The course introduces concepts of computational fluid dynamics (CFD) and focuses on engineering applications of CFD. Students will learn how to use CFD tools to model internal and external flows in a wide range of architectural, chemical, civil, and mechanical engineering applications. Projects offer students flexibility in selecting their applications. Example semester long projects include design of room air distribution systems, indoor and outdoor air quality, natural ventilation, heat transfer coefficient calculations, pipe flow, rotating reference frame, and more.
Lecture: 3 Lab: 0 Credits: 3

CAE 408
Bridge and Structural Design
Design of modern bridges, bridge design requirements, LRFD approach, seismic and wind effects, fatigue in bridges, support design.
Prerequisite(s): CAE 431*, An asterisk (*) designates a course which may be taken concurrently.
Lecture: 3 Lab: 0 Credits: 3
Satisfies: CAE Design Course (D)

CAE 410
Introduction to Wind and Earthquake Engineering
Kinematics of Particles, Newton's laws of motion, energy and momentum. Kinematics of rigid bodies. Fundamentals of free, forced, and transient vibration of single and multi-degree of freedom structures. Analysis and design of structures for wind and earthquake loadings. Building code requirements. Instructor’s consent may be granted to students who do not meet the prerequisite.
Prerequisite(s): CAE 411*, An asterisk (*) designates a course which may be taken concurrently.
Lecture: 3 Lab: 0 Credits: 3

CAE 411
Structural Analysis II
The analysis of statically indeterminate frames. Application of classical methods including superposition, slope deflection, and moment distribution. Introduction to the direct stiffness method and computer analysis of structures.
Prerequisite(s): CAE 304 or Graduate standing
Lecture: 3 Lab: 0 Credits: 3

CAE 412
Traffic Engineering Studies and Design
Basic traffic engineering studies including traffic volume, speed, accident, and parking studies. Capacity and analysis for various traffic facilities. Design of traffic control devices.
Lecture: 3 Lab: 0 Credits: 3
Satisfies: CAE Design Course (D)

CAE 415
Pavement Design, Construction and Maintenance
Pavement types, stresses in flexible and rigid pavements, vehicle pavement interaction. Mathematical models for pavement systems, sub grade support, design of flexible and rigid pavements. Construction procedure, drainage considerations, environmental effects. Rehabilitation and maintenance of pavements.
Prerequisite(s): CAE 323 or Graduate standing
Lecture: 3 Lab: 0 Credits: 3

CAE 416
Facility Design of Transportation Systems
Design and analysis of facilities of transportation systems. Integration of select transportation components and their interrelationships. Design of specific facilities: guide ways, terminals, and other elements for railroads, airports, and harbors.
Lecture: 3 Lab: 0 Credits: 3
Satisfies: CAE Design Course (D)

CAE 417
Railroad Engineering and Design
Lecture: 3 Lab: 0 Credits: 3
Satisfies: CAE Design Course (D)

CAE 419
Introduction to Transportation Engineering and Design
Highway functions, design controls and criteria, element of design, cross-section elements, local roads and streets, at-grade intersections, grade separation and interchanges, highway capacity analysis, and introduction to pavement management.
Lecture: 3 Lab: 0 Credits: 3
Satisfies: CAE Design Course (D)

CAE 421
Risk Assessment Engineering
Description and concept of risk, relationship between the likelihood of loss and the impact of loss, engineering hazards assessment and risk identification and evaluation using fault tree analysis, failure mode and effect analysis, etc., risk analyses applications with practical statistics.
Lecture: 3 Lab: 0 Credits: 3
CAE 422
Sprinklers, Standpipes, Fire Pumps, Special Suppression, and Detection Systems
Review and introduction to fluid dynamics applied to sprinklers, standpipes, fire pumps, and special suppression systems; hydraulic design criteria and procedures for sprinklers requirements, standpipes, fire pumps, special suppression systems, and detection and alarm systems using nationally recognized design (National Fire Protection Association) standards, water supply requirement systems and distributions.
Prerequisite(s): CAE 209 or CAE 302 or Graduate standing
Lecture: 3 Lab: 0 Credits: 3

CAE 424
Introduction to Fire Dynamics
Introduction to fire, physics and chemistry, and mass and heat transfer principles, fire fluid mechanic fundamentals, fundamentals and requirements of the burning of materials (gases, liquids, and solids), fire phenomena in enclosures such as pre-flashover and post-flashover.
Prerequisite(s): CAE 209 or Graduate standing
Lecture: 3 Lab: 0 Credits: 3

CAE 425
Fire Protection and Life Safety in Building Design
Fundamentals of building design for fire and life safety. Emphasis on a systematic design approach. Basic considerations of building codes, fire loading, fire resistance, exit design, protective systems, and other fire protection systems.
Lecture: 3 Lab: 0 Credits: 3

CAE 430
Probability Concepts in Civil Engineering Design
Introduction to probability, modeling, and identification of nondeterministic problems in civil engineering. Development of stochastic concepts and simulation models and their relevance to design and decision problems in various areas of civil engineering.
Prerequisite(s): MATH 252 or Graduate standing
Lecture: 3 Lab: 0 Credits: 3
Satisfies: CAE Design Course (D)

CAE 431
Steel Structures II
Additional topics in the design of steel structures and study of how the behavior of members and the overall structural system inform the design of the structure. Design of typical steel frame systems, as well as composite floor construction and plate girders. Design of bolted and welded connections.
Prerequisite(s): CAE 303
Lecture: 3 Lab: 0 Credits: 3
Satisfies: CAE Design Course (D)

CAE 432
Concrete Structures II
Behavior and design of reinforced concrete beams and columns. Serviceability requirements for reinforced concrete beams. Behavior and design of reinforced concrete foundations – topics include anchor bolts, spread footings, pile caps, and retaining walls.
Prerequisite(s): CAE 307
Lecture: 3 Lab: 0 Credits: 3
Satisfies: CAE Design Course (D)

CAE 433
Repair of Existing Building Structures
Building repair and retrofit issues are discussed. Specific requirements of a building for repair and/or reconstruction are emphasized. Methods of assessing building conditions, including forensic structural engineering are covered. Repair and strengthening methods based on types of materials (steel, concrete, masonry, timber), occupancy and function (residential, commercial), and building values are covered along with demonstration case studies and illustrative examples.
Prerequisite(s): CAE 432 and CAE 431
Lecture: 3 Lab: 0 Credits: 3

CAE 435
Experimental Analysis of Structures
The analysis of structures (prototypes) with the aid of models constructed from metal, wood, plastics, and other materials. Geometrical, mathematical, demonstration, graphical and direct and indirect models will be treated. Comparisons of experimental results with results from computer models will be made. Similitude and the theory of models will be treated. Individual and group project work will be emphasized.
Prerequisite(s): (CAE 304 and CAE 411) or Graduate standing
Lecture: 2 Lab: 2 Credits: 3

CAE 436
Design of Masonry and Timber Structures
Design of unreinforced and reinforced masonry structural elements and structures. Serviceability and ultimate capacity design. Seismic response, resistance, and design. Design of wood columns and bending members. Mechanical fasteners and connectors. Instructor’s consent may be granted to students who do not meet the prerequisite.
Prerequisite(s): CAE 307 or Graduate standing
Lecture: 3 Lab: 0 Credits: 3
Satisfies: CAE Design Course (D)

CAE 437
Homeland Security Concerns in Engineering Systems
Review of blast effects produced by solid phase weapons and their effects on structures and people. Estimation of the risk of threats to security of public and private systems and facilities. Review of simplified structural methods for the analysis and design of structures to meet homeland security concerns and procedures to minimize casualties. Analysis of post-attack fires and how to prevent them. Examination of potential risk to security of infrastructure systems. Development of contingency plans to include evacuation preparedness at time of emergency.
Lecture: 3 Lab: 0 Credits: 3

CAE 438
Control of Building Environmental Systems
Prerequisite(s): CAE 331 or CAE 513 with min. grade of C or MMAE 322
Lecture: 3 Lab: 0 Credits: 3
CAE 439
Introduction to Geographic Information Systems
Geographic information system (GIS) technology allows databases which display and query information in new ways. This course will teach general GIS and GPS skills and concepts, useful to students and practitioners in a variety of disciplines. Students will complete a final GIS project relevant to their field of study. This hands-on class will use ESRI's Arc View and Spatial Analyst products, as well as Trimble GeoExplorer GPS units.
Lecture: 3 Lab: 0 Credits: 3

CAE 453
Measurement and Instrumentation in Architectural Engineering
Hands-on experience with energy and indoor air quality measurements in buildings including experimental design, data analysis, and experimental statistics. Measurements and techniques covered include: thermal performance (e.g., thermal conductivity and resistance, heat flux, and temperature); fluid flows and HVAC characteristics (e.g., velocity, pressure, and airflow); energy performance (e.g., current, voltage, and power draw); whole building diagnostics (e.g., blower door and duct blaster); and indoor air quality (e.g., tracer gas techniques for air exchange, particle measurements, and gas measurements). Course combines lectures and field measurements in buildings on campus.
Prerequisite(s): CAE 331
Lecture: 3 Lab: 0 Credits: 3

CAE 454
Building Commissioning
This course introduces students to the fundamentals and practice of building commissioning and prepares students for the Building Commissioning Professional (BCxP) Certification Exam. Building commissioning is an integrated process of quality assurance (QA), quality control (QC), and communications that is utilized to ensure that all of its systems, including mechanical, electrical, lighting, plumbing, fire protection, acoustical, and controls, perform interactively and according to the design intent. Building commissioning also ensures that building operators are prepared to operate and maintain its systems and equipment, which saves time, money, and energy, and improves the sustainability and resilience of buildings. This course is open to all majors that have familiarity with buildings and their systems.
Prerequisite(s): CAE 331 or INTM 407 or (ARCH 403 and ARCH 404)
Lecture: 3 Lab: 0 Credits: 3

CAE 457
Geotechnical Foundation Design
Methods of subsoil exploration. Study of types and methods of design and construction of foundations for structures, including single and combined footings, mats, piles, caissons, retaining walls, and underpinning. Drainage and stabilization.
Prerequisite(s): CAE 323 or Graduate standing
Lecture: 3 Lab: 0 Credits: 3
Satisfies: CAE Design Course (D)

CAE 461
Plumbing and Fire Protection Design
Study of plumbing systems, water supply, and venting systems. Study of fire protection systems for buildings including pipe sizing, pumps, sprinklers, gravity and pressure vessels, and controls.
Prerequisite(s): CAE 302 or CAE 209 or MMAE 313 or Graduate standing
Lecture: 3 Lab: 0 Credits: 3
Satisfies: CAE Design Course (D)

CAE 463
Building Enclosure Design
Design of building exteriors, including the control of heat flow, air and moisture penetration, building movements, and deterioration. Study of the principle of rain screen walls and of energy conserving designs. Analytical techniques and building codes are discussed through case studies and design projects.
Prerequisite(s): CAE 331 or Graduate standing
Lecture: 3 Lab: 0 Credits: 3
Satisfies: CAE Design Course (D)

CAE 464
HVAC Systems Design
Study of the fundamental principles and engineering procedures for the design of heating, ventilating, and air conditioning systems; HVAC system characteristics; system and equipment selection; duct design and layout. Attention is given to energy conservation techniques and computer applications.
Prerequisite(s): CAE 331 or CAE 513
Lecture: 3 Lab: 0 Credits: 3
Satisfies: CAE Design Course (D)

CAE 465
Energy Conservation in Buildings
Prerequisite(s): CAE 331 or CAE 513
Lecture: 3 Lab: 0 Credits: 3
Satisfies: CAE Design Course (D)

CAE 466
Building Electrical/Lighting Systems Design
Study of the analysis and design of electrical systems in buildings utilizing the National Electric Code. Topics include AC, DC, single-phase and three-phase circuits, transients, branch circuits, panel boards, system sizing, fault calculations and overcurrent protection design. Also studies the design and specification of emergency power backup and alternative power systems.
Prerequisite(s): CAE 383 or (ECE 216 and ECE 215)
Lecture: 3 Lab: 0 Credits: 3
CAE 467
Lighting Systems Design
An intensive study of the calculation techniques and qualitative aspects of good luminous design. Topics covered include: photometric quantities and color theory, visual perception, standards, daylight and artificial illumination systems, radiative transfer, fixture and lamp characteristics, control devices, and energy conservation techniques. Design problems, field measurements, computer, and other models will be used to explore major topics.
Lecture: 3 Lab: 0 Credits: 3

CAE 468
Architectural Design
Architectural Design is the first of a two-part sequence of architectural design and planning for architectural engineers. Students learn the basic theory and practice of the architectural design process from the architect's perspective. Topics include the logical process of architectural design development, integration of code requirement, design approach, and architectural presentation techniques taught through lecture and lab instruction.
Lecture: 2 Lab: 2 Credits: 3

CAE 470
Construction Methods and Cost Estimating
The role of estimating in construction contract administration. Types of estimates. Unit costs and production rates; job costs. Preparing bid for complete building project using manual methods and the CSI format; checking quantity take-off and cost estimating in selected divisions using a computer package.
Lecture: 3 Lab: 0 Credits: 3
Satisfies: Communications (C), CAE Design Course (D)

CAE 471
Construction Planning and Scheduling
Lecture: 3 Lab: 0 Credits: 3
Satisfies: CAE Design Course (D)

CAE 472
Construction Site Operation
Lecture: 3 Lab: 0 Credits: 3

CAE 473
Construction Contract Administration
Characteristics of the construction industry. Project delivery systems. Duties and liabilities of the parties at the pre-contract stage. Bidding. Contract administration including duties and liabilities of the parties regarding payments, retainerage, substantial and final completion, scheduling and time extensions, change orders, changed conditions, suspension of work, contract termination, and resolution of disputes. Contract bonds. Managing the construction company. Labor law and labor relations.
Lecture: 3 Lab: 0 Credits: 3

CAE 474
Introduction to Building Information Modeling
Fundamentals and practical use of information technologies in design; basic concepts of building information modeling (BIM); review of software and technology available for BIM; practical use of BIM in design for creating a site, viewing a model, starting a project, working in the AutoDesk "Revit" Environment, adding basic building elements to a project, conceptual energy analysis, designing a preliminary layout, and presenting a project.
Lecture: 3 Lab: 0 Credits: 3

CAE 479
Fundamentals of Engineering Preparation
Review of the materials covered in the Fundamentals of Engineering (FE) Examination. Demonstrations of solution methods, practice problems and practice exams, and strategies for preparing for and taking the FE examination. Senior and Graduate students only.
Lecture: 0 Lab: 0 Credits: 0
Satisfies: Ethics (E)
CAE 497  
Special Project  
Special design project under individual supervision of instructor.  
Prerequisite: Senior standing, minimum GPA of 3.0, and consent of instructor.  
Credit: Variable